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ABSTRACT

A longitudinal study examined differences in Chinese-American and Euro-American parents' facilitation of their young children's mathematics learning. Participating in the Time 2 data collection were 36 second-generation Chinese-American and 40 Euro-American first and second graders from well-educated suburban Chicago families. Children were given the Sequential Assessment of Mathematics Inventories (SAMI); mothers and fathers completed questionnaires assessing parental beliefs, attitudes, and practices; and mother-child and father-child dyads were videotaped separately helping their child solve a word problem within the child's zone of proximal development. Findings indicated that Chinese-American children scored significantly higher on the total SAMI and on the computation and word problem subtests that European American subjects, and spent almost four times more per day on mathematics homework. Chinese-American parents reported using more systematic, formal methods of mathematics teaching and less use of incidental teaching embedded in context than did Euro-American parents. In the videotaped teaching session, Chinese-American parents interacted longer and received higher ratings on writing scale use than Euro-American parents. In mother-child dyads, Chinese-American children were rated as more self-reliant than were Euro-American children. Chinese-American mothers explained new concepts to a greater degree than did Euro-American mothers, and Chinese-American fathers sat closer to children than did Euro-American fathers. Euro-American mothers gave more directives and encouraged their children more than Chinese-American mothers. Euro-American children produced more speech acts per minute than did Chinese American children. Quantitative analyses of interactions revealed more similarities than differences between Chinese- and Euro-American parents but subtle differences in teaching styles were revealed through qualitative analyses. (Contains 12 references.) (KDFB)

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# Cultural Differences in Parents' Facilitation of Mathematics Learning: A Comparison of Euro-American and Chinese-American Families

Carol S. Huntsinger — College of Lake County
Paul E. Jose — Loyola University Chicago

Paper presented in the Home Connections Symposium at the American Educational Research Association 1997 Annual Meeting, Chicago, IL, March 25, 1997.

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Cultural Differences in Parents' Facilitation of Mathematics Learning:

A Comparison of Euro-American and Chinese-American Families

The mathematics superiority of Chinese-American children in the United States has been well-documented (e.g., Caplan, Choy, & Whitmore, 1992; Stevenson et al., 1990). Mathematics performance of Chinese-American children is superior to that of Euro-American children as early as preschool and kindergarten (Huntsinger, Jose, Liaw, & Ching, 1997). Huntsinger et al. attributed the early mathematics difference to cultural differences in parents' beliefs and practices rather than to differences in school curricula since the children had attended very similar early childhood programs.

Many studies of cross-cultural differences in mathematics performance have relied on survey data. Vygotskian theory emphasizes the importance of social interaction with a mentor in the cognitive development of a child. Cognitive development occurs through joint participation in an activity by a novice and an expert. (Rogoff, 1990). The social processes involved in guided participation can best be evaluated through observational studies. However, there is a dearth of observational data to document the processes involved in parental teaching, especially in different cultural contexts. To date, most observational studies of parental teaching have been conducted with white populations and have utilized mothers teaching their children (e.g., Diaz, Neal, & Vachio, 1991; Roberts & Barnes, 1992). One exception is a study by Steward and Steward (1974) which involved observations of six mothers from each of three cultural groups (Anglo-, Mexican-, and Chinese-American) teaching their young sons. They found that ethnicity was the best predictor of maternal teaching and child response. In particular, Chinese-American mothers used a high proportion of enthusiastic feedback and provided more specific instructions than Anglo-American mothers.

Differences in teaching styles have been found in comparisons of Asian teachers with American teachers (e. g., Stigler & Perry, 1988). Since parents are the primary teachers of young children, we thought that perhaps the early mathematics difference could partially be explained by ethnic group differences in parental teaching style. Would differences similar to those found in classroom teaching be found in parental teaching? In particular, do parents in the two cultural groups differ in the ways they teach mathematics to their children? Are Chinese-American parents using more

effective techniques or more effective teaching styles? If so, it may be possible to adopt the more effective techniques or styles to boost the mathematics performance of other children in the United States.

We are conducting a longitudinal study designed to look at how Chinese-American and Euro-American parents facilitate the mathematics development of their young children. At Time 1 of our longitudinal study (1993) Chinese-American parents were found to be more directive than Euro-American parents when teaching a counting game to their preschool and kindergarten children (Jose, Huntsinger, Huntsinger, & Liaw, 1996). The current study from the Time 2 data collection (1995) assesses parental (fathers and mothers) teaching of mathematics word problems to their first and second grade children. Because the Time 2 task was more prescribed and less open-ended, parents in both groups were expected to be more directive than they had been at Time 1, based on the finding of Roberts and Barnes (1992) that parents are more directive in a task-oriented session than in a free play session.

## Method

Subjects. Thirty-six second-generation Chinese-American children (16 first-graders; 20 second-graders) and forty Euro-American children (20 first graders; 20 second-graders) from well-educated families in the suburban Chicago area participated in this Time 2 data collection in a longitudinal study. Of the total of 76 families in the study, 70 mother-child dyads (32 Chinese-American, 38 Euro-American) and 68 father-child dyads (31 Chinese-American, 37 Euro-American) agreed to be videotaped. Mean ages of the children were 7.75 years for the Chinese-American children (16 girls, 16 boys) and 7.70 years for the Euro-American children (19 girls, 19 boys). (See Table 1 for sample characteristics.) One Chinese-American father and one Euro-American father chose not to be videotaped, resulting in two fewer father-child dyads than mother-child dyads.

Procedure. Children were individually given the Sequential Assessment of Mathematics Inventories (Reisman & Hutchinson, 1985) and several other measures in a quiet room at their school during the spring of their first or second grade year. Eight-page questionnaires assessing parental beliefs, attitudes, and practices were mailed to mothers and fathers. Questions answered by the

parents included how much daily mathematics homework their child's teacher assigned and how much additional mathematics homework the parents assigned. The experimenter then visited each child's home to interview the parents as a couple. In the interview, the parents were asked, "How do you facilitate your child's development in mathematics?" All methods parents used to facilitate mathematics were coded on a Likert-type scale from 1 (informal, simple, incidental) to 3 (more formal, complex, systematic) by the first author and a college early childhood education instructor. High interrater reliability (Cohen's kappa = .81) was achieved. The parents' methods were then coded with 1, 2, or 3 and the arithmetic average of each family's methods was computed.

In addition, videotapes were made of the father and the mother individually helping their child to solve a word problem within the child's zone of proximal development. This was achieved by selecting two word problems just slightly more difficult than the highest level problems the child had correctly solved on the SAMI. Mother-child dyads and father-child dyads were each given a pencil and a word problem typed on a separate sheet of white paper. Parents were asked to help their child find a solution. Only the parent-child dyad being videotaped was present in the room; the other parent did not observe the first dyad being videotaped. Several of the Chinese-American parents spoke in Chinese or a mixture of Chinese and English. The Chinese was translated by our Taiwan-born research assistant.

A rating scale was developed using the same general behavior ratings we had used in our Time 1 observations of mother-father-child triads (Jose et al., 1996). Also, we developed two additional scales: teaching techniques and use of writing. (See appendix for scale items and Cronbach's alphas.) Ratings for individual items were independently made on 7-point bipolar scales by two female research assistants, one Chinese-American and one Euro-American. Interrater reliability was determined by the hits and misses method. When the raters were within one point of each other on an item, a hit was scored. If the difference in their ratings was greater than one, a miss was scored. Interrater reliability ranged from 71% hits for the mothers' directive scale to 90% hits for the fathers' warmth scale.

The papers containing the mathematics problems and the writing done by parents and children were examined to determine the types of representation parents and children had used in the process of solving the problems. We noted whether dyads used numerical or pictorial representation (either, neither, or both).

In addition to the global ratings, a more fine-grained analysis was used to aid our understanding of the dyadic interactions. To that end the dyads' conversations were transcribed by two research assistants. A graduate student and the first author then coded each speech act, using a 10-speech act coding scheme for each of the two interlocuters. The following scheme was used: DIR (directive), STA (statement), QUE (asks question), ANS (answers question), CB (compliant behavior), NB (non-compliant behavior), ENC (encouraging comment or encouraging behavior), AGR (agreement), DIS (disagreement), REA (reads aloud). Ten randomly selected parent-child interactions (4 Chinese-American, 6 Euro-American) were coded by both coders and interrater agreement of 91% was obtained. Differences were easily resolved. Bakeman and Quera's (1995) sequential analysis program was then used to compute the conditional probabilities among parent and child speech act categories (e.g., directives, statements, questions, etc.) for each ethnic group separately to reveal dyadic patterns involved in parental teaching.

## Results

Mathematics achievement. A series of 2 (ethnicity) x 2 (sex of child) ANOVAs with grade level as a covariate revealed striking cultural differences. Chinese-American children ($M$ = 82.75) scored significantly higher than Euro-American children ($M$ = 70.03) on the total SAMI, and on the computation ($M$s = 19.88, 13.40) and word problem ($M$s = 5.61, 4.60) subtests, $F$s (1, 72) = 13.60, 24.95, 4.98; $p$s < .0001, .0001, .05. No sex of child differences or interactions emerged.

Mathematics homework and parental teaching methods. Chinese-American children spent an average of 20.6 minutes per day on mathematics homework, as compared to the Euro-American average of 4.7 minutes, $F$ (1, 70) = 28.15, $p$ < .0001. Chinese-American parents ($M$ = 2.37) reported using more systematic, formal methods to teach mathematics to their children, whereas Euro-

American parents (M = 1.74) reported more use of incidental teaching embedded in context, F (1, 72) = 27.73, p < .0001. (See Table 2 for specific teaching methods.)

Videotaped interaction ratings. In the videotaped interaction ratings, cultural differences emerged in two of the eight scales. A 2 (ethnicity) x 2 (sex of parent) MANOVA revealed that Chinese-American parents received higher ratings on the use of writing scale, F (3, 62) = 3.14, p < .05. Univariate results showed Chinese-American parents paid closer attention to what their child was writing (M = 5.76) and gave greater emphasis to the correct written form of the problem (M = 4.47) than Euro-American parents (Ms = 5.30, 3.50, respectively), Fs (1, 64) = 4.42, 5.68, ps < .05. Also, in the mother-child dyads, Chinese-American children (M = 4.39) were rated as more self-reliant than were Euro-American children (M = 3.73), F (1, 66) 4.29, p < .05.

Several differences on single-item ratings emerged. Chinese-American mothers (M = 3.08) explained new concepts to a greater degree than did Euro-American mothers (M = 1.95), F (1,68) = 7.33, p < .01. Chinese-American fathers (M = 5.60) sat closer to their children than did Euro-American fathers (M = 5.09), F (1,66) = 5.90, p < .05. Ethnicity differences did not emerge on the parent scales of directiveness, clarity, teaching techniques, and warmth; nor on the child scales of warmth and quiet-control. Overall there were more similarities than differences.

The interactions of the Chinese-American parents (M = 4.65 min.) were significantly longer than those of the Euro-American parents (M = 3.73 min.), F (1, 68) = 4.54, p < .05. The interactions of Euro-American mothers (M = 3.25) were considerably shorter than those of Euro-American fathers (M = 4.23), Chinese-American mothers (M = 4.74), and Chinese-American fathers (M = 4.56). The Euro-American mothers tended to choose the easier of the two problems, which may explain their shorter interaction times.

Types of written representation. In the Chinese-American group, 51% of the dyads used numerical representation only; 5% of the dyads used pictorial representation only; 38% used both numerals and pictures; and 6% did no writing. In the Euro-American group, 41% of the dyads used numerical representation only; 23% used pictorial representation only; 19% used both; and 17% did

no writing. This data corroborates the above behavior ratings where Chinese-American parents were found to use more writing in the problem-solving interaction.

Verbal participation rates. Four MANOVAS performed on the speech acts per minute revealed several univariate ethnic group differences in verbal participation. (See Tables 3 and 4.) In the mother-child dyads, Euro-American mothers gave more directives and more encouraging comments to their children than did Chinese-American mothers. Euro-American children gave more directives to their mothers and displayed more compliant behavior than did Chinese-American children. Summing across speech acts, Euro-American children produced more speech acts per minute than Chinese-American children in the mother-child interactions.

In the father-child dyads, Euro-American fathers uttered more agreements and used more encouraging comments than did Chinese-American fathers. Euro-American children answered more questions than did Chinese-American children. Summing across speech acts, Euro-American children produced more speech acts per minute than did Chinese-American children when interacting with fathers.

Sequential lag results. The purpose of this analysis was to determine whether the conversations differed between the Chinese-American and Euro-American dyads when parents were teaching their children. Jose (1988) has shown how dialogic patterns of communication can be empirically abstracted from conversation coded at the level of speech acts. Because parents were asked to help their child solve particular math problems, the conversations were scripted rather than open-ended. We would expect, therefore, to find a high number of lag 1 connections. In this analysis using Bakeman and Quera's (1995) sequential analysis program, we collapsed over mothers and fathers and over gender of child. Each lag 1 connection represents a significant conditional probability, $z > 2.57$, $p < .01$. Lag 1 connections with frequencies of fewer than 10 were not included.

Chinese-American dyads and Euro-American dyads each yielded 30 significant lag 1 connections. Twenty-three of the connections were common to both ethnic groups. (See Figure 1.) Regarding parent to child links in both groups, parent directives were followed by child compliant

behaviors; parent statements were followed by child agreements; parent questions were followed by child answers and child questions; parent reading was followed by child reading; and parent encouragements were followed by child statements. In Chinese-American dyads only, both parent answers and parent agreements were followed by child statements. (See Figure 2.) In Euro-American dyads only, parent directives were followed by child noncompliance; parent questions and parent disagreements were followed by child agreements; and parent statements were followed by child disagreements. (See Figure 3.)

Regarding parent to parent links in both groups, parent directives were followed by parent directives; parent agreements were followed by parent directives; parent disagreements were followed by parent directives; parent statements were followed by parent statements and by parent questions; parent reading was followed by parent reading; and parent agreements were followed by parent encouragements. In Chinese-American dyads, parents gave two successive disagreements. In the Euro-American dyads, parents gave two successive encouraging comments.

Regarding child to parent links in both groups, child compliant behaviors and child statements were followed by parent agreements; child questions were followed by parent answers and by parent disagreements; child answers were followed by parent agreements and parent disagreements; child agreements were followed by parent statements; and child reading was followed by parent reading. In Chinese-American dyads only, child statements were followed by both parent disagreement and parent encouragement; and child reading was followed by parent agreement. In Euro-American dyads, child reading was followed by parent disagreement.

Regarding child-to-child links in both groups, child compliant behaviors were followed by child reading, and child reading was followed by child reading. In Chinese-American dyads there were no unique child-to-child links. In Euro-American dyads only, child statements were followed by child statements, as in a mini-monologue.

## Discussion

At Time 2 Chinese-American children continued to perform higher in mathematics than Euro-American children. Chinese-American parents continued to use more formal methods to teach their children and their children spent much more time on mathematics homework.

Overall, more similarities than differences emerged in the comparison of Chinese-American and Euro-American parent-child dyads engaged in problem-solving interactions. In the interaction behavior ratings, Chinese-American dyads made more use of written representation of the problems than did Euro-American dyads. In mother-child dyads, Chinese-American children were rated as more self-reliant than Euro-American children, and Chinese-American mothers explained new concepts to a greater degree than did Euro-American mothers. In father-child dyads, Chinese-American fathers sat closer to their children. Parents in the two ethnic groups were rated as equally warm, directive, clear, and involved in problem-solving. Children in the two groups were rated as equally warm and controlled.

Contrary to expectations, in verbal participation rates, Euro-American mothers gave more directives per minute to their children than Chinese-American mothers. Euro-American children were more likely not to comply with parental directives, and to disagree with parental statements. Also, Euro-American children gave more directives to their mothers. These behaviors suggest that there may be less emphasis on respect for parental authority or greater emphasis on child assertiveness in the Euro-American culture.

Both Euro-American mothers and fathers gave more encouraging comments to their children than did Chinese-American parents. Also Euro-American fathers used more agreements. The greater use of encouraging comments by Euro-American parents corroborates findings of a similar study of Chinese-American and Euro-American fifth and sixth-grade girls and their parents in triadic interactions (Huntsinger & Jose, 1995).

Although many similarities in parental teaching style were observed, the cultural differences that emerged are interesting. Euro-American children's reading was followed by parental disagreement (correction), while Chinese-American children's reading was followed by parental

agreement. It was observed that Chinese-American children had less difficulty in reading the problems and were less apt to need correction of their reading, even though they were bilingual.

While there was no ethnic group difference in the number of parent disagreements given, the form that the disagreements took differed. Chinese-American parents were more direct. For example,

Mom: Do you know how many is 4 x 4?

Child: 18

Mom: (Shakes her head no.)

Child: I mean 20.

Mom: (Shakes her head no.) No, no, no. Try one more time. You know that.

Child: So it's 4–8–12–16.

Mom: Good. It's 16.

On the other hand, it appeared that some Euro-American parents were afraid to directly tell their children that their answer was wrong. Therefore, Chinese-American children might be getting clearer, immediate feedback. For example, one Euro-American mother said, "Mmmm--well, I don't think that's quite the right answer though." Two other Euro-American examples follow:

Child: 14? (incorrect answer)

Dad: Well----------

Child 16? (incorrect answer)

Dad: O. K. Well,------O. K.

Mom: Can you figure it?

Child: 4 (incorrect)

Mom: Okay.

Chinese-American parents also referred much more often to higher (than grade level) math that the child already knew, whereas Euro-American parents referred to the same concepts as something they would learn in the future. For example, in Chinese-American dyads:

1. Dad: You already learned multiply and divide. So what would this problem be?

   Child: Multiply.

2. After reading the problem, Dad says: Is this a plus question?

   Child: No, it's times.

3. Dad: How many times [tables] can you repeat OK?

   Child: Four times

4. After the child selected subtraction as the appropriate process, mom asked for the child's rationale. "Why don't you add? Why don't you do times?"

In contrast, several examples from Euro-American dyads follow:

1. Mom: You're probably going to learn this in 5th grade or something.

2. Dad: In school, they're going to teach you how to do multiplication and division.

Our results so far lead us to conclude that parents in both cultures use similar teaching styles in teaching mathematics to their children. Quantitative analyses of the interactions revealed more similarities than differences between Chinese-American and Euro-American parent-child dyads. The subtle differences in the teaching styles revealed through a qualitative look are important to investigate further. What appears to be more important than parental teaching style is the systematic nature of the Chinese-American parental teaching, the use of more formal methods, and the amount of time Chinese-American young children spend doing mathematics homework assigned by their parents. (See Huntsinger, Jose, Liaw, and Ching (1997) for details.)

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Table 1

Sample Demographics

| | Chinese-American | | Euro-American | |
|---|---|---|---|---|
| | Mean | S.D. | Mean | S.D. |
| Mean age of child | 7.75 | .34 | 7.70 | .32 |
| Number of boys in sample | 18 | | 20 | |
| Number of girls in sample | 18 | | 20 | |
| Number of children in family | 2.21 | .55 | 2.41 | .71 |
| Mother's mean age | 39.38 | 2.88 | 38.88 | 4.40 |
| Father's mean age | 41.77 | 3.09 | 41.62 | 4.84 |
| Mother's mean educational attainment | 16.73 | 1.94 | 17.18 | 1.32 |
| Father's mean educational attainment | 18.23 | 2.21 | 17.68 | 1.81 |
| Hollingshead status score mean | 59.83 | 6.81 | 60.77 | 4.63 |

Table 2

Ethnicity Differences in Parents' Reports of Mathematics Facilitation Methods

| | Chinese-Am. Frequency | Euro-Am. Frequency | $X^2$ | p |
|---|---|---|---|---|
| Parent states, "No flashcards or drill." (1) | 0 | 5 | 4.82 | .05 |
| Teach through play (e.g., playing store) (1) | 2 | 4 | .51 | NS |
| Real-life situations (e.g., helping with cooking) (1) | 3 | 28 | 29.83 | .0000 |
| Card games, board games (1) | 2 | 10 | 5.39 | .05 |
| Computer programs (2) | 4 | 14 | 5.98 | .05 |
| Help with counting (2) | 1 | 7 | 4.36 | .05 |
| Give more practice with problems at grade level (2) | 15 | 14 | .36 | NS |
| Emphasize the memorization of math facts (2) | 7 | 0 | 8.57 | .01 |
| Older sibling teaches younger child new material (3) | 6 | 0 | 7.23 | .01 |
| Give challenging math problems while driving (3) | 4 | 5 | .03 | NS |
| Provide additional math teaching materials (3) | 20 | 10 | 7.40 | .01 |
| Takes mental math or abacus in Chinese School (3) | 5 | 0 | 5.95 | .05 |
| Systematic preteaching of higher level material (3) | 17 | 5 | 11.11 | .001 |

Notes. The numbers in parentheses are the ratings given to the math methods on a 3-point scale with 1 representing play-oriented methods embedded in context, 2 representing extra practice with mathematics at the child's grade level, and 3 representing methods which incorporate mathematics beyond the child's grade level.

Table 3

Mother-Child Dyads: Ethnic Group Differences in Speech Acts/Minute

| Speech Act | Chinese-American Mothers | Euro-American Mothers | F | Chinese-American Children | Euro-American Children | F |
|---|---|---|---|---|---|---|
| Statement | 3.93 | 3.55 | .72 | 1.17 | 1.17 | .00 |
| Question | 4.62 | 4.23 | .32 | .48 | .66 | 1.57 |
| Answer | .27 | .39 | 1.03 | 2.22 | 2.68 | 2.25 |
| Directive | 1.53 | 2.30 | 6.00* | .02 | .17 | 4.16* |
| Agreement | 1.56 | 1.61 | .05 | .79 | .81 | .08 |
| Compliant Behavior | .01 | .04 | 1.18 | .50 | .88 | 6.44* |
| Non-Compliant Behavior/ Discouraging Comment | .01 | .00 | 1.18 | .03 | .06 | .69 |
| Encouraging Comment/ Encouraging Behavior | .36 | .64 | 5.81* | .02 | .03 | .08 |
| Disagreement | .49 | .41 | .36 | .06 | .09 | .63 |
| Reads Aloud | .36 | .68 | 2.30 | .58 | .85 | .88 |
| Total Utterances | 13.13 | 13.86 | .50 | 5.86 | 7.40 | 5.25* |

Notes. Ns = 32 Chinese-American dyads, 38 Euro-American dyads.

*$p < .05$.

Table 4

Father-Child Dyads: Ethnic Group Differences in Speech Acts/Minute

| Speech Act | Chinese-American Fathers | Euro-American Fathers | F | Chinese-American Children | Euro-American Children | F |
|---|---|---|---|---|---|---|
| Statement | 3.69 | 3.89 | .09 | 1.02 | .99 | .00 |
| Question | 4.03 | 4.89 | 2.55 | .45 | .39 | .34 |
| Answer | .24 | .26 | .06 | 2.62 | 3.25 | 2.93† |
| Directive | 1.86 | 2.15 | .91 | .08 | .13 | .84 |
| Agreement | 1.52 | 2.18 | 4.40* | .65 | .98 | 2.25 |
| Compliant Behavior | .01 | .02 | .18 | .68 | 95 | 2.09 |
| Non-Compliant Behavior/ Discouraging Comment | .00 | .01 | .16 | .09 | .18 | 1.27 |
| Encouraging Comment/ Encouraging Behavior | .21 | .67 | 5.37* | .03 | .03 | .00 |
| Disagreement | .62 | .62 | .00 | .10 | .15 | .37 |
| Reads Aloud | .37 | .32 | .23 | .44 | .66 | 2.16 |
| Total Utterances | 12.58 | 15.04 | 3.39† | 6.15 | 7.70 | 5.34* |

Notes. Ns = 31 Chinese-American dyads, 37 Euro-American dyads.

†$p < .10$. *$p < .05$.

Appendix

## Parent Scales

**Directive Scale** Cronbach's alpha = .70 (father-child), .64 (mother-child)

| | |
|---|---|
| (-) Tells child how to do problem. | Expects child to come up with own solution. |
| Gives child time to think and ask questions. | Proceeds rapidly and does the majority of the talking |

**Clarity Scale** Cronbach's alpha = .65 (father-child), .62 (mother-child)

| | |
|---|---|
| Speaks rapidly | Speaks slowly |
| (-) Explanation is clear to child. | Explanation is confusing to child. |
| (-) Organized in approach. | Disorganized in approach. |

**Teaching Techniques Scale** Chronbach's alpha = .76 (father-child), .71 (mother-child)

| | |
|---|---|
| (-) Extends learning beyond given problem. | Stops when child reaches correct solution. |
| (-) Deeply involved in problem-solving. | Shows little involvement in problem solving. |

**Warmth Scale** Cronbach's alpha = .80 (father-child), .69 (mother-child)

| | |
|---|---|
| (-) Enjoys interaction with child. | Irritated, impatient with child. |
| (-) Warm, loving relationship with child. | Cool, reserved in relationship with child. |
| (-) Light-hearted, not serious. | Serious |
| (-) Emotionally expressive. | Emotionally unexpressive. |

**Use of Writing Scale** Cronbach's alpha = .53 (father-child), .57 (mother-child)

| | |
|---|---|
| Pays little attention to what child is writing. | Pays close attention to what child is writing. |
| (-) Makes much use of pencil to represent or to solve problem. | Makes no use of pencil to represent problem. |
| (-) Emphasis on correct written form. | No writing used. |

## Child Scales

**Warmth** Cronbach's alpha = .77 (child-father), .79 (child-mother)

| | |
|---|---|
| (-) Emotionally very expressive | Emotionally very unexpressive. |
| (-) Warm toward parent. | Irritated, impatient with parent. |
| (-) Respectful of parent | Hostile toward parent. |
| (-) Visibly enjoys interaction with parent. | Appears to have an unpleasant time. |

**Quiet-Control** Cronbach's alpha = .62 (child-father), .49 (child-mother)

| | |
|---|---|
| Moves around a lot. | Sits very still |
| Easily distracted. | Intense concentration. |
| (-) Whispers, soft-spoken with parent. | Loud, assertive with parent. |

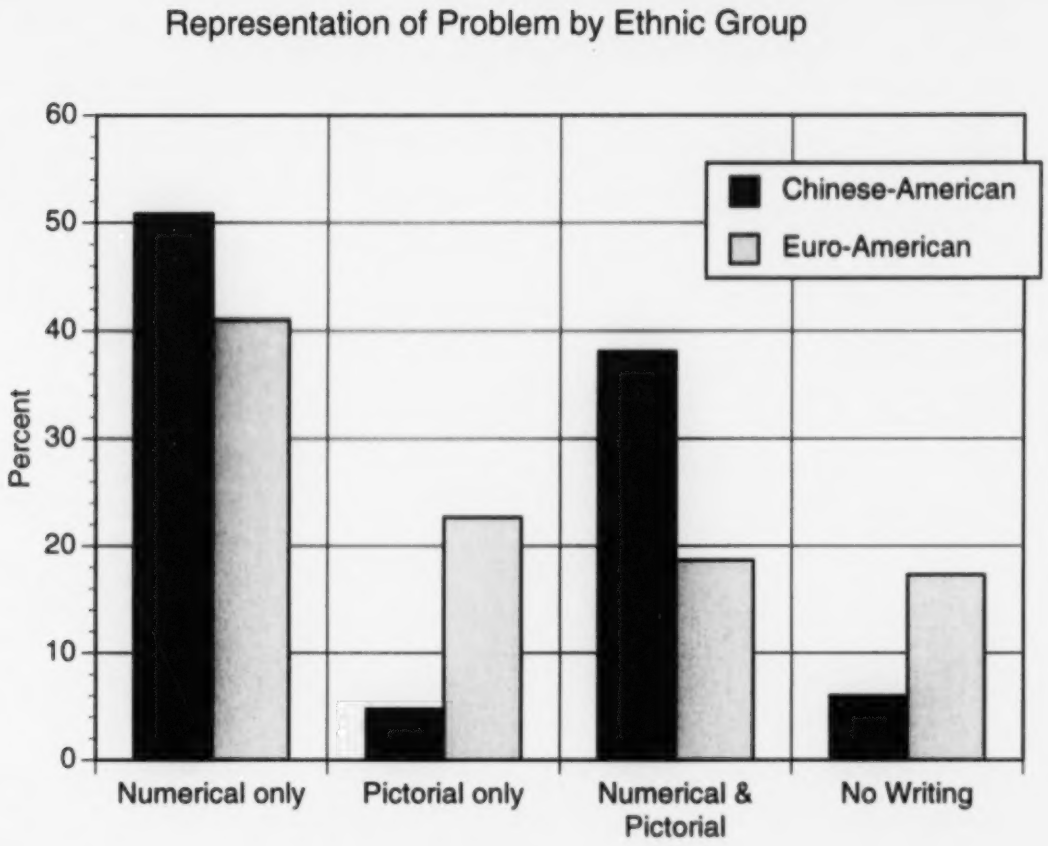
**Self-Reliant** Cronbach's alpha = .63 (child-father), .51 (child-mother)

| | |
|---|---|
| (-) Self-directed | Waits for parent to lead |
| (-) Expresses/uses own ideas for solving problem | Offers no ideas of his/her own. |
| (-) Child makes much use of pencil | Child does not use pencil at all. |
| (-) Child reads problem very fluently. | Child does no observable reading. |

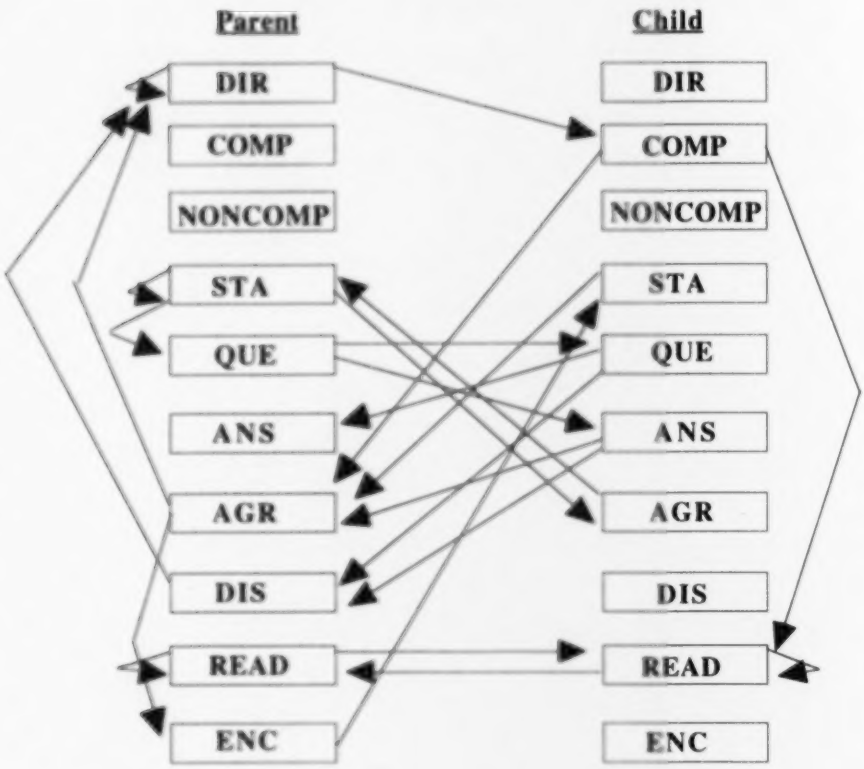
Figure 1. Speech act contingencies common to both cultural groups.

Figure 2. Speech act contingencies unique to the Chinese-American dyads.

Figure 3. Speech act contingencies unique to the Euro-American dyads.

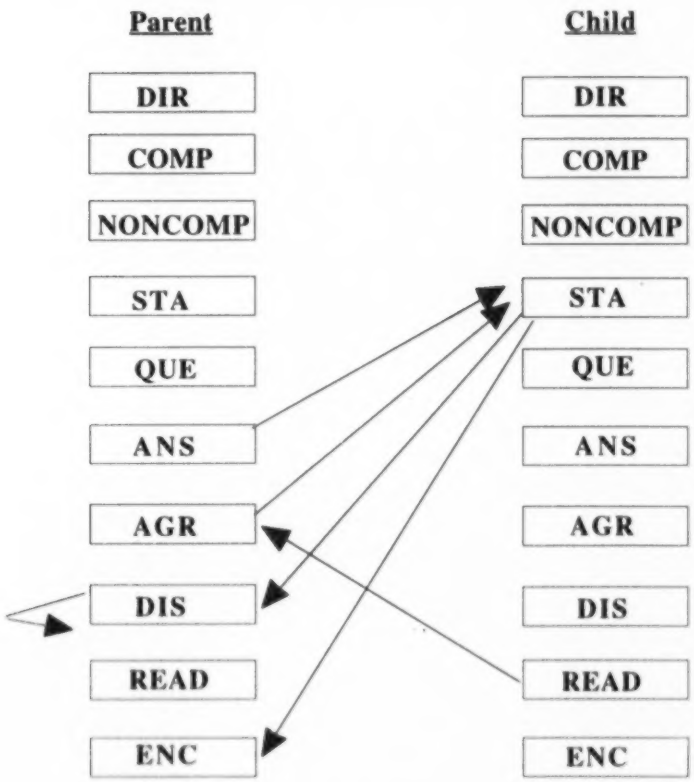

Representation of Problem by Ethnic Group
60
50
40
30
20
10
0
Percent
Chinese-American
Euro-American
Numerical only
Pictorial only
Numerical & Pictorial
No Writing

## Links Common to Both Ethnic Groups



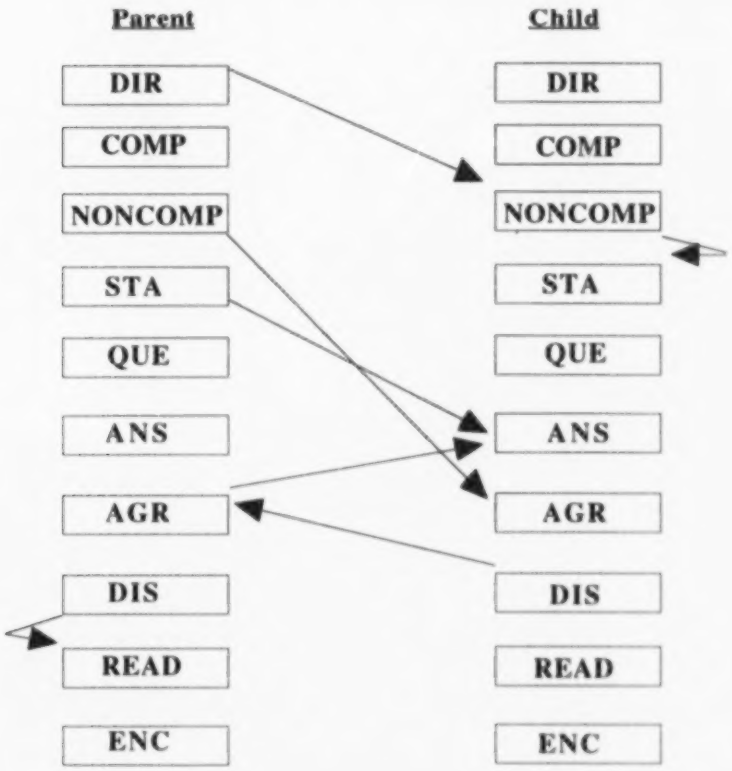

Note. An arrow between two acts denotes a significant ($p < .01$) conditional probability (i.e., the occurrence of the second speech act after the first exceeds base probability). DIR = directive, COMP = compliant behavior, NONCOMP = noncompliant behavior, STA = statement, ANS = answer, AGR = agreement, DIS = disagreement, READ = reads aloud, ENC = encouraging comment

## Unique Chinese-American Links




Note. An arrow between two acts denotes a significant ($p < .01$) conditional probability (i.e., the occurrence of the second speech act after the first exceeds base probability). DIR = directive, COMP = compliant behavior, NONCOMP = noncompliant behavior, STA = statement, ANS = answer, AGR = agreement, DIS = disagreement, READ = reads aloud, ENC = encouraging comment

## Unique Euro-American Links




Note. An arrow between two acts denotes a significant ($p < .01$) conditional probability (i.e., the occurrence of the second speech act after the first exceeds base probability). DIR = directive, COMP = compliant behavior, NONCOMP = noncompliant behavior, STA = statement, ANS = answer, AGR = agreement, DIS = disagreement, READ = reads aloud, ENC = encouraging comment

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